Indiana Lakes Nutrient Criteria

Ideas for Implementation in IDEM's 305(b) Assessment and 303(d) Listing Processes

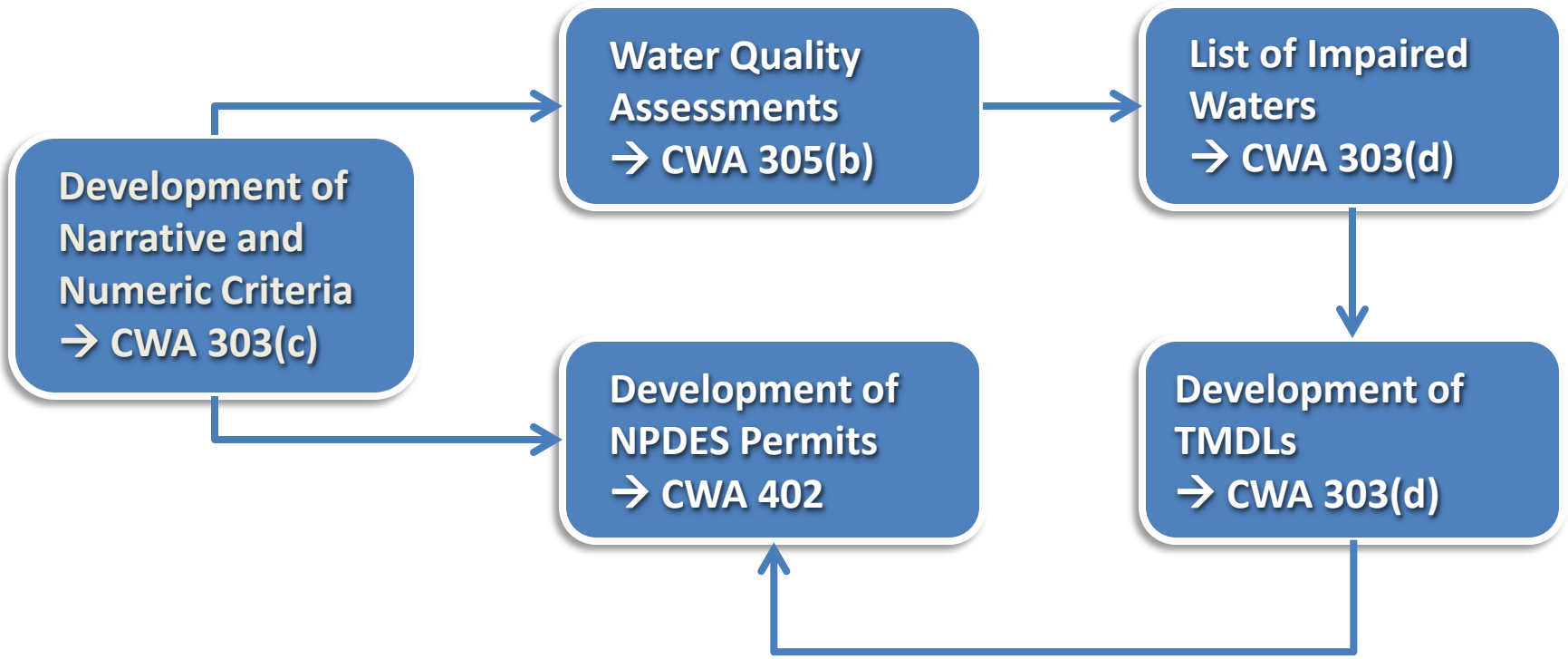
Jody Arthur
Integrated Report Coordinator
Office of Water Quality, IDEM

February 28, 2012 Work Group Meeting

Outline

- Framework for implementation
- Overview of IDEM's lakes assessments
- IDEM's current 305(b)/303(d) assessment and listing processes for lakes
- U.S. EPA expectations regarding 305(b) assessments and how they affect methodology and monitoring
- IDEM's draft 305(b)/303(d) assessment and listing methodology for lakes
- Comparison of current monitoring efforts and how they might need to change
- Q&A

Roadmap for Implementation of Nutrient Criteria for Lakes



IDEM's CWA Assessments of Lakes

- Two types of lakes assessments
  - CWA 305(b) Assessments
  - CWA 314 Assessments
- Both are described in IDEM's Consolidated Assessment and Listing Methodology (CALM)
- Assessment methodology informs our data collection activities
- Both rely on similar data but decision making processes and criteria differ

CWA 314 Assessments

- Describe trend and trophic state of a lake
  - Trophic state = the point at which the lake resides along the continuum of its life
  - Trend = How trophic conditions are changing over time
- Not a statement of water quality
- Based on a trophic score calculated from a multi-metric index
  - Indiana State Trophic Index uses 10 indicators including TP, Chlorophyll *a*, and Secchi Depth
- Do not result in a 303(d) listing or trigger TMDL development

CWA 305(b) Assessments

- For a lake, a 305(b) assessment describes the degree to which anthropogenic eutrophication may be impacting
  - Our ability to use the lake for recreation
  - The ability of the lake to support healthy aquatic communities
- Can result in a 303(d) listing, triggering the requirement to develop a TMDL

Current 305(b) Assessment Methodology for Lakes

- Data are evaluated against numeric benchmarks in accordance with IDEM's CALM
  - Total Phosphorus (TP)
  - Chlorophyll *a* (Chl *a*)
  - Trophic State Index (TSI) score
- Benchmarks established in 2008 based on data analysis by Limno-Tech, Inc.
  - Additional analyses have refined these numbers
  - Benchmarks will be replaced with numeric criteria once adopted

Comparison of Current Benchmarks and Proposed Criteria

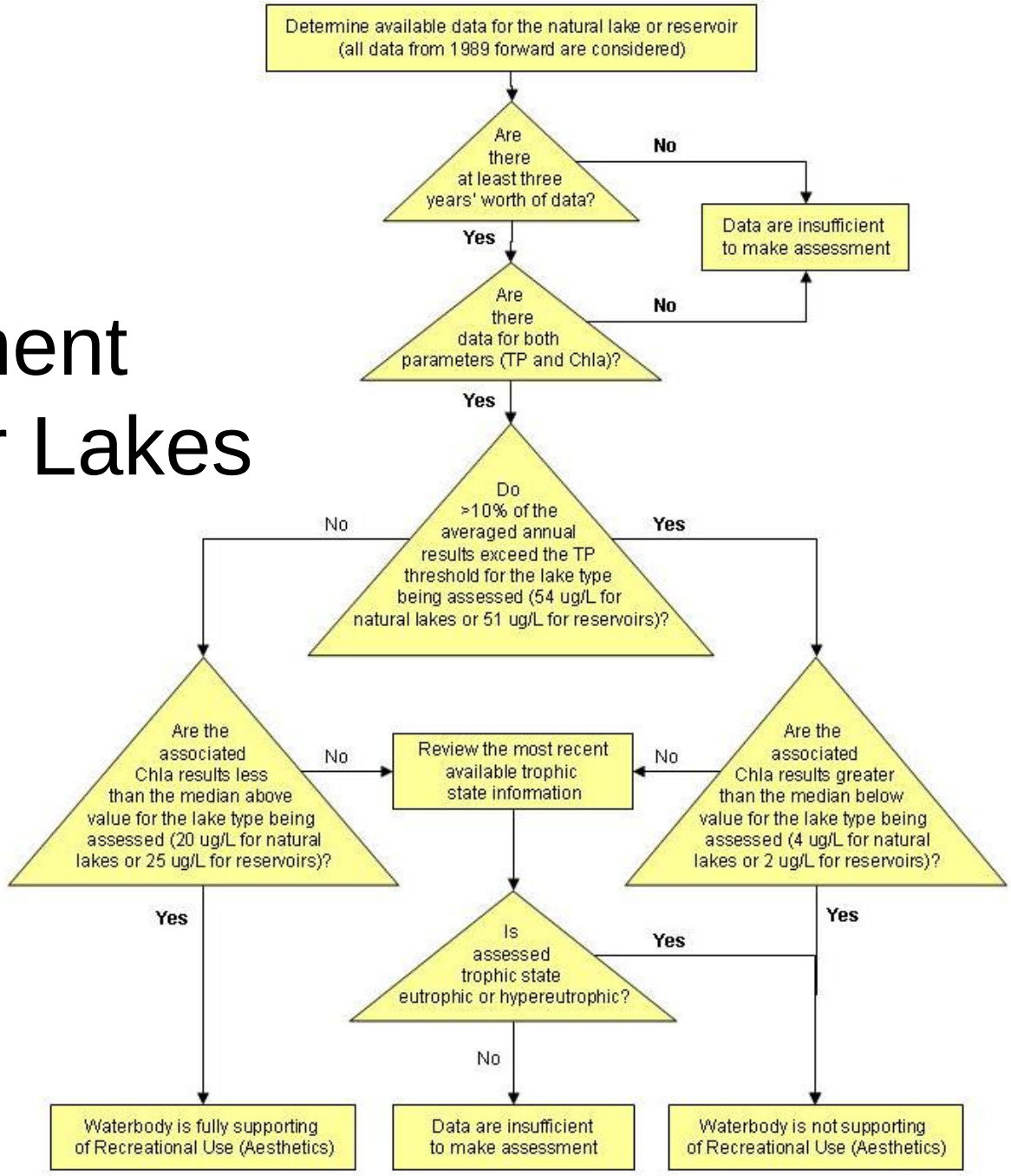
Lake Type	Current Benchmarks (ug/L)	Proposed Criteria (ug/L)
TP (Natural Lakes)	54	25 (modified 25-98)
TP (Reservoirs)	51	35 (modified 35-126)
Chl *a* (Natural Lakes)	4 - 20	8
Chl *a* (Reservoirs)	2 - 25	8

Components of a 305(b) Assessment Methodology

- Indiana's WQS provide the basis for IDEM's 305(b) assessment methodologies
- Components of a 305(b) assessment methodology:
  - The designated use(s) to be assessed
  - Period of record for data to be evaluated
  - Minimum data requirements, including types of parameters and the number of results for each
  - Sampling frequency and if results will be averaged
  - Seasonality if expressed in the WQS
  - Number of times the criteria may be exceeded

IDEM's Current 305(b) Assessment Methodology for Lakes

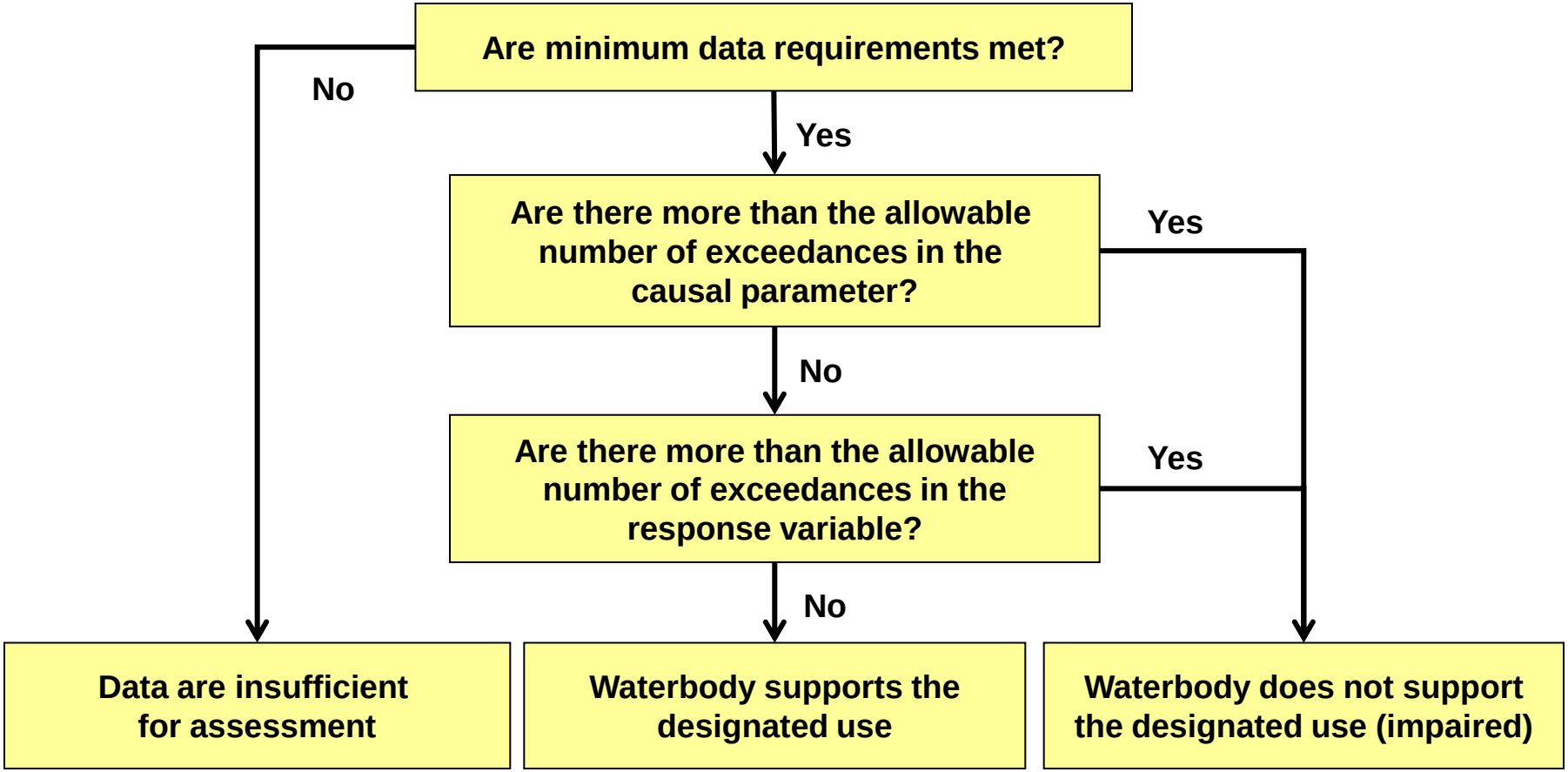
- Developed in 2008 based on results from Limno-Tech, Inc.
- Implemented using data collected by Clean Lakes Program (IU-SPEA)



U.S. EPA's Expectations

- U.S. EPA policy requires the use of independent applicability in CWA 305(b) assessments
  - Applied to all types of indicators used for assessment
  - With regard to lakes, both causal and response variables must be evaluated independently
- How much data do you need to be confident in the assessment decision?

Simplified Model of IA as applied in 305(b) assessments



Types of Error Within the Context of Assessments

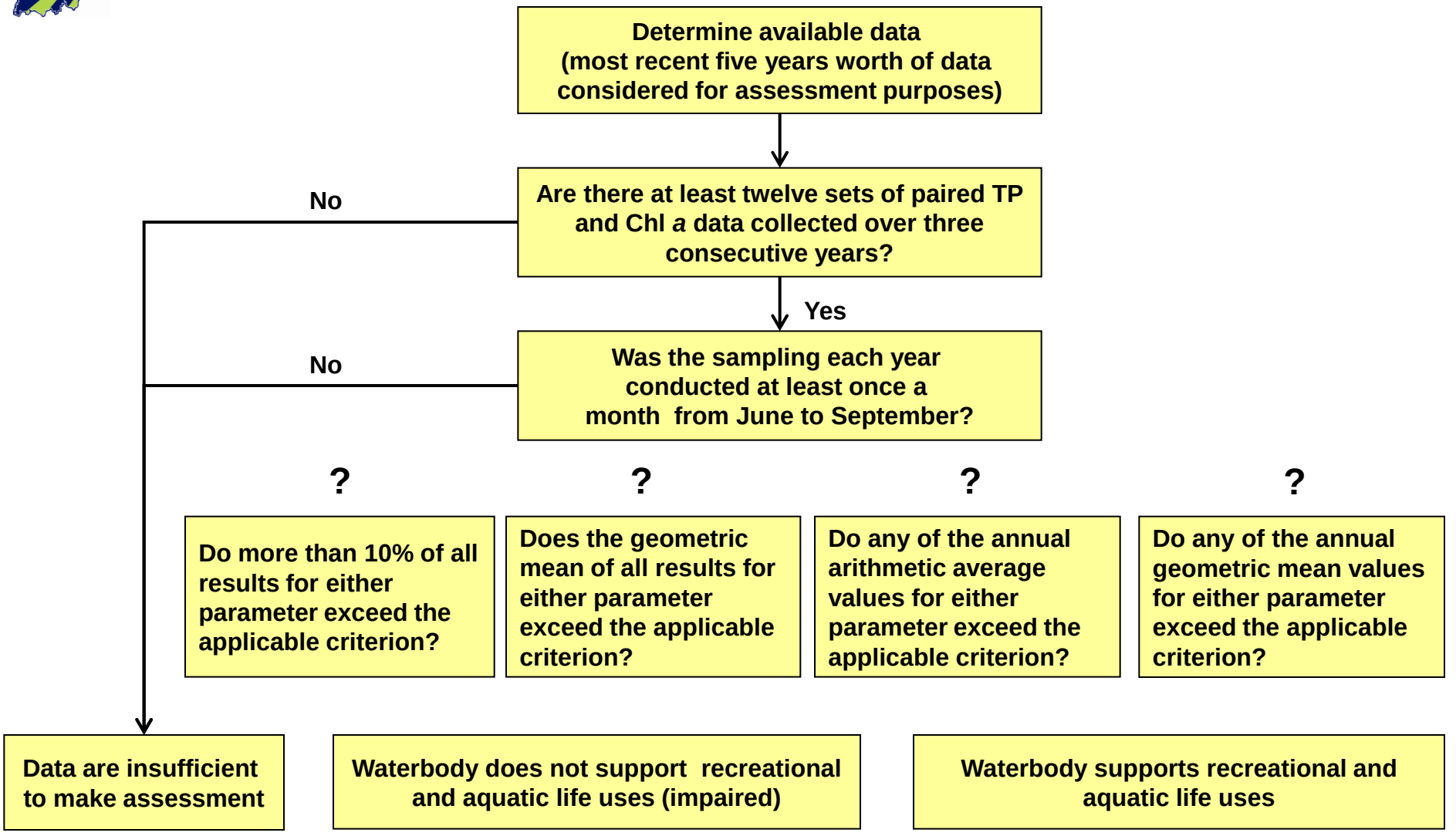
- When developing a CWA 305(b) assessment methodology, decision error is a key consideration
- Type I error results in an assessment of impairment and subsequent 303(d) listing when the waterbody is not really impaired (false positive)
  - Very likely here in Indiana, particularly with lakes that have high levels of non-algal turbidity
- Type II errors (false negatives) mean that we might be missing some impairments
  - Highly unlikely because the independent applicability approach errs on the side of water quality protection

Impacts of Assessment Errors

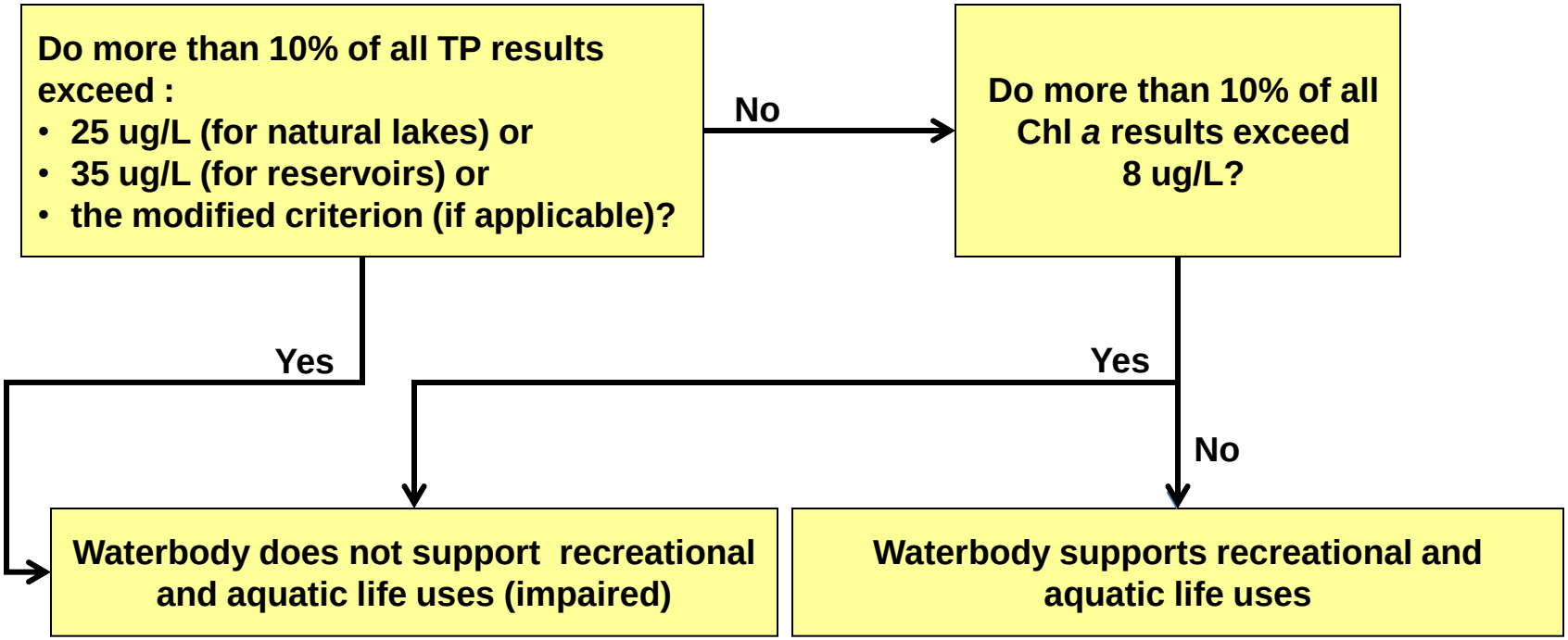
- Type I errors
  - Potentially wasted resources working to restore a waterbody that isn't really impaired
  - Indirect impacts to permitted facilities
- More data will help to ensure that our assessment decisions are reliable
- Accuracy in our 303(d) listing translates into limited resources more effectively allocated to real impairments

Methodology Component	Current Methodology	Draft Methodology (bolded items still under discussion)
Designated Use(s)	Recreational Use	Recreational and Aquatic Life uses
Period of Record	All data from 1989	Most recent five (5) years
Parameters	TP + Chl *a* +/- TSI score	TP + Chl *a*
Minimum Number Results	Three (3) sets of paired TP and Chl *a* results and one (1) TSI score	**Twelve (12) sets of paired TP and Chl *a* results**
Minimum Sampling Frequency	• Once a year for three (3) years • May be nonconsecutive years • Multiple results w/n a single year averaged	• **Four (4) times per year for three (3) consecutive years** • **No averaging of multiple results w/n each year (unless using annual arithmetic averages or geometric means for decision rule)**
Seasonality	July – August	June – September
Number Exceedances Allowed	No more than 10% of all TP values exceed and their corresponding Chl *a* values are below the applicable median	**Possible approaches:** • **10% rule independently applied to the total number of results for each parameter** • **Geometric mean of all results for each parameter does not exceed applicable criterion, applied independently** • **No annual arithmetic average for either parameter exceeds the applicable criterion** • **No geometric mean for either parameter exceeds the applicable criterion**

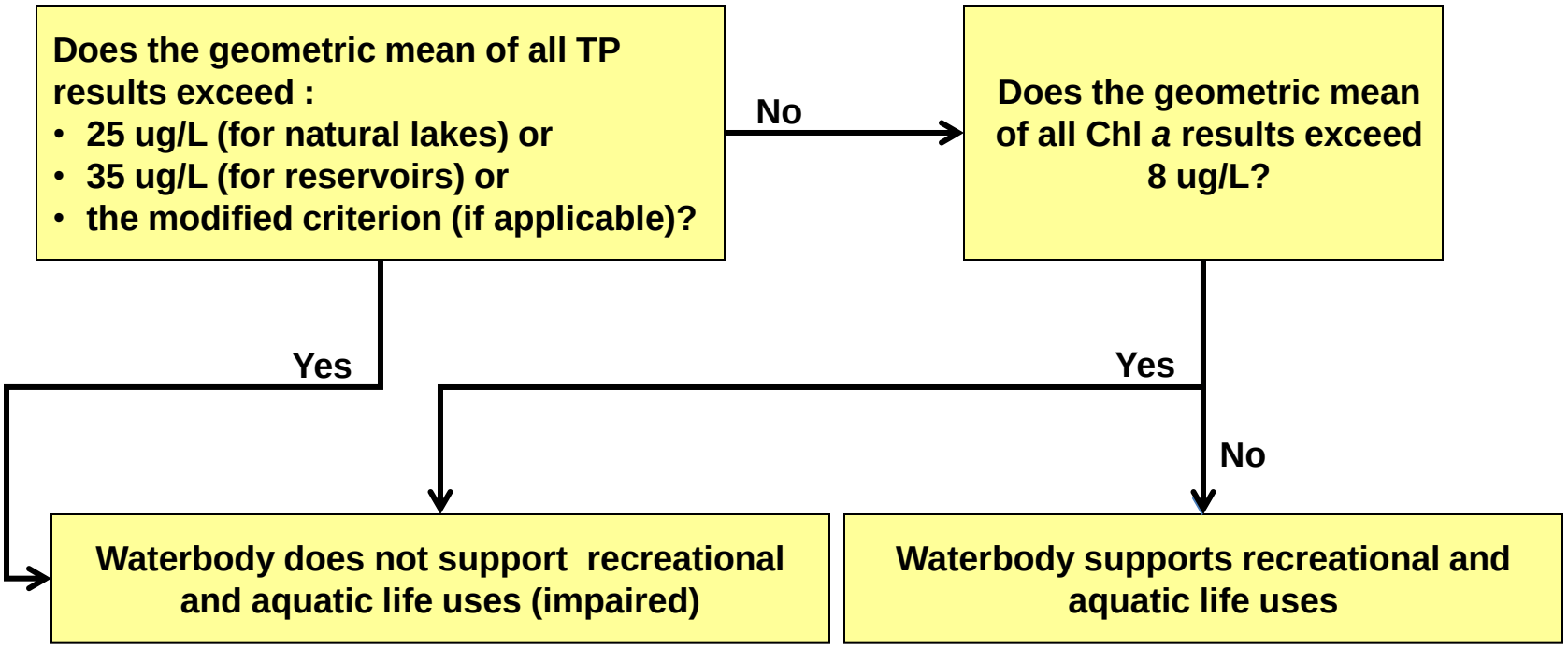
Simplified Assessment Model



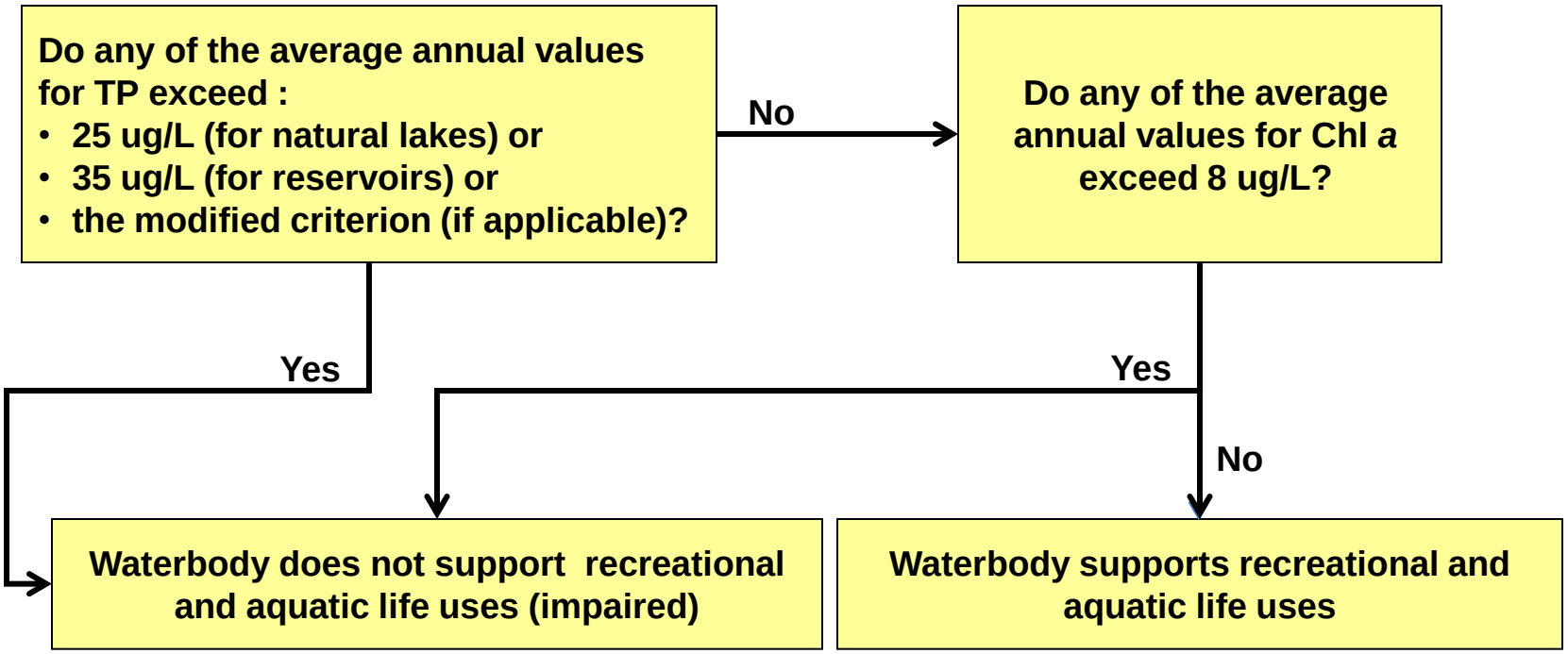
Example of a 10% Rule



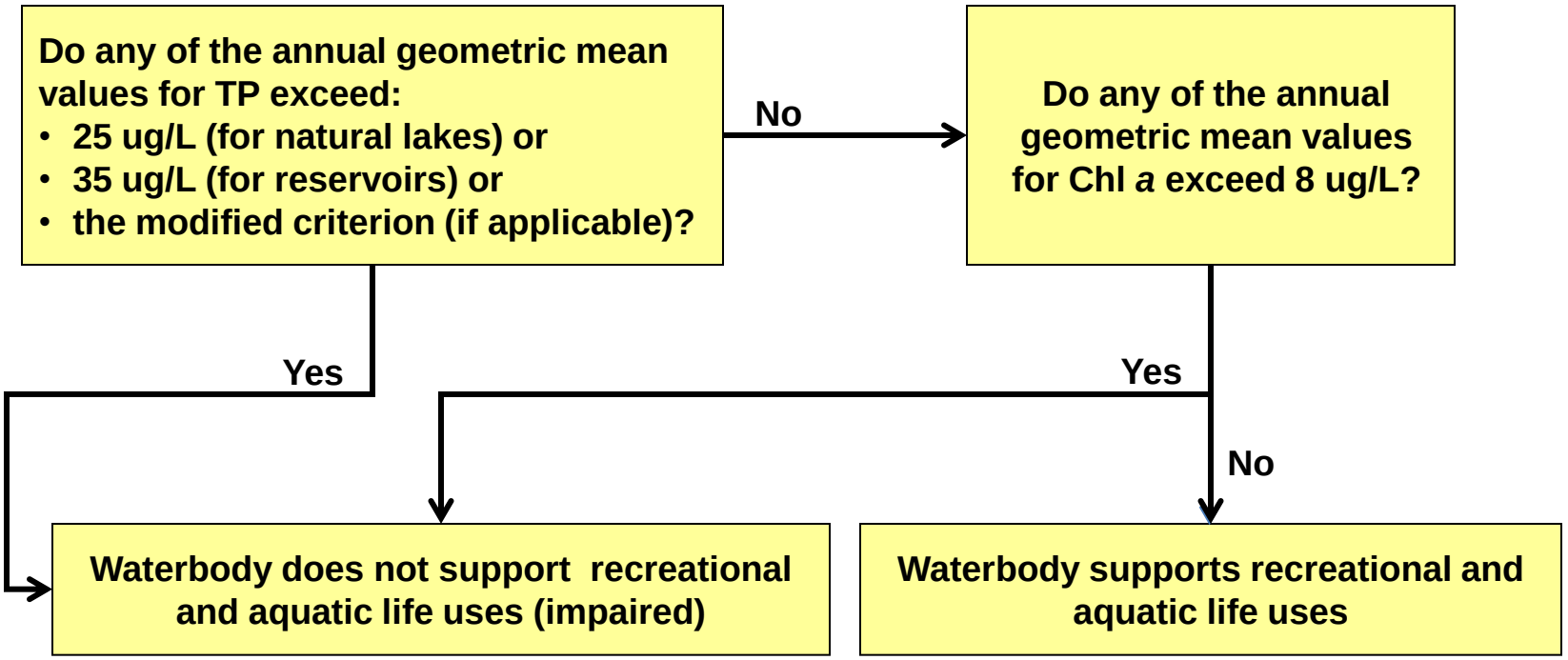
Example of a Geometric Mean Rule



Example of How We Might Use An Arithmetic Average



Example of How We Might Use an Annual Geometric Mean



Current Monitoring to Support IDEM's Lakes Assessments

- Clean Lakes Program (CLP) funded with IDEM's Nonpoint Source Program grants
  - Volunteer monitoring
  - IU SPEA
- CLP monitoring strategy initially developed to support CWA 314 assessments
- In 2008, IDEM began using a subset of these data for 305(b) assessments

Current Monitoring to Support IDEM's Lakes Assessments

- Volunteer monitoring
  - Volunteers take Secchi Depth readings and collect water samples for analysis by IU-SPEA
  - Some also collect algal samples for analysis by IU-SPEA and additional data using multi-parameter probes
- IU-SPEA
  - Graduate students conduct all these types of monitoring and analyze all water samples they and volunteers collect

Current Monitoring to Support IDEM's Lakes Assessments

- TP and Chl *a* results for all samples analyzed by IU-SPEA labs are used to make CWA 305(b) assessments
- Results from samples collected through expanded volunteer program and by IU-SPEA are used to calculate a TSI score for CWA 314 assessments

Monitoring to Support Future 305(b) Lakes Assessments

- Could theoretically use the same minimum requirements that we employ in our current assessments
  - We already know that using this approach with baseline criteria will result in >65% impairment, regardless of lake type
- Considering a phased approach to monitoring
  - Minimum data requirements for 305(b) assessment initially match those required to develop modified criteria
  - Scaling back on monitoring efforts once there are sufficient data to determine appropriate criteria (baseline or modified)

Current Monitoring Costs

- The IU-SPEA component of the CLP collects one summer sample from 80 lakes per year
- The expanded volunteer component of the CLP collects samples to be analyzed by IU-SPEA for another ~50 lakes per year
- Both components provide TP and Chl *a* data
- Original strategy provided data for most lakes throughout the state over a period of 4-5 years
- Total annual cost of the monitoring and analyses is approximately $90K

Back of the Envelope

Methodology Component	Current Methodology	Draft Methodology (bolded items still under discussion)
Minimum Number Results	Three (3) sets of paired TP and Chl *a* results and one (1) TSI score	**Twelve (12) sets of paired TP and Chl *a* results**
Minimum Sampling Frequency	• Once a year for three (3) years • May be nonconsecutive years • Multiple results w/n a single year averaged	• **Four (4) times per year for three (3) consecutive years** • **No averaging of multiple results w/n each year (unless using annual arithmetic averages or geometric means for decision rule)**

- Draft methodology = 12 results, 4x what we currently use
- 130 lakes divided by 4 results each year = 33 lakes/year
- 500 lakes total divided by 33 lakes/year = 15 years

Advantages, Disadvantages of a Phased Approach

Advantages

- Confidence in assessment decision → Won't artificially grow our list of impaired waters
- Allows determination of most appropriate criteria for each lake
- More effective use of limited resources

Disadvantages

- Time consuming → With 500 lakes to monitor, the first phase will take many years, assuming static or reduced funding levels
- Expensive (maybe)

Remaining Questions

- Monitoring and Assessment go hand-in-hand for implementation of nutrient criteria
- Current program and the monitoring and assessment options presented here represent only the polar ends of a spectrum of choices
- Best implementation scenario will balance decision error (and associated costs) with the costs of monitoring
  - Anticipated cuts in federal funding for water programs (CWA 319 and 106)

Questions?

Jody Arthur
Integrated Report Coordinator
Office of Water Quality, IDEM
jarthur@idem.IN.gov
317-308-3179